JACKSONVILLE HARBOR DEEPENING STUDY

CIRCULATION AND SALINITY MODELING

Presented by:

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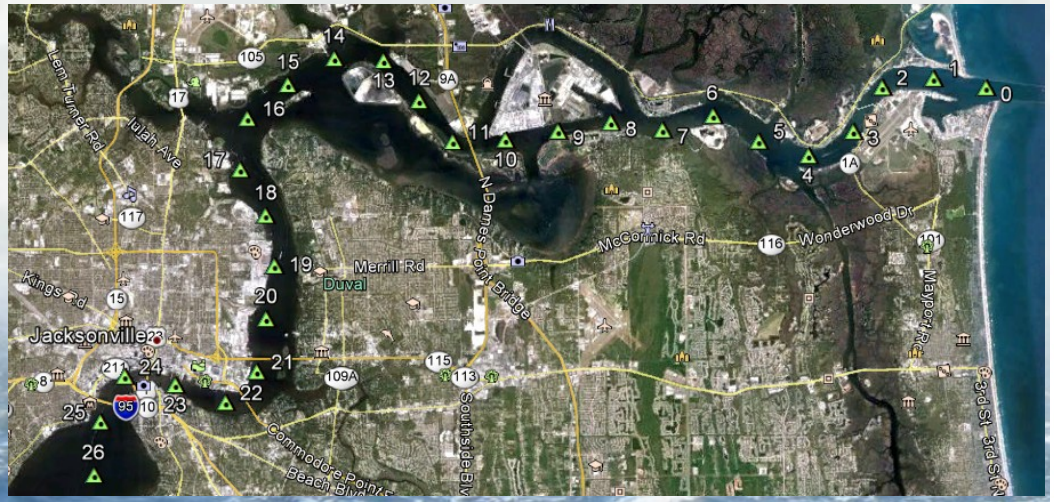
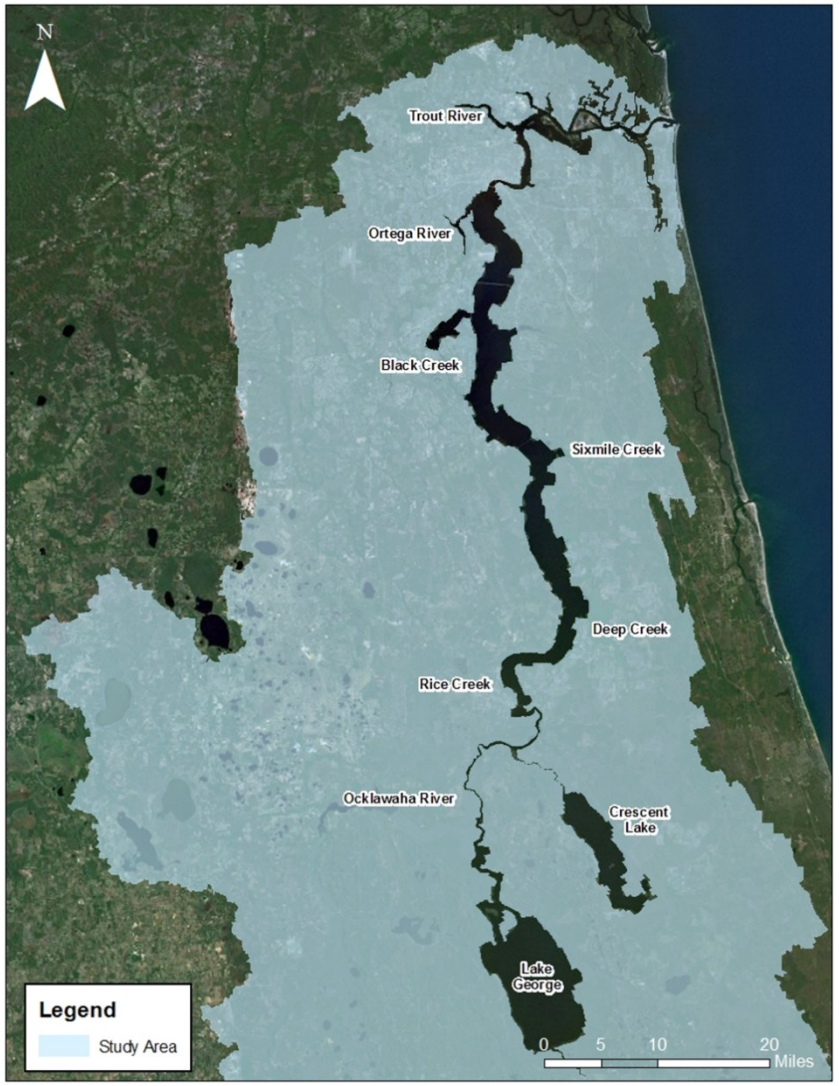
TAYLOR ENGINEERING, INC.

Study Area and Project Area

- Lower (northern) 124 mi of the St. Johns River
- From mouth near Mayport to upstream of Astor
- Project area extends to the first 14 miles of the St. Johns River or from river mouth to the cruise terminal

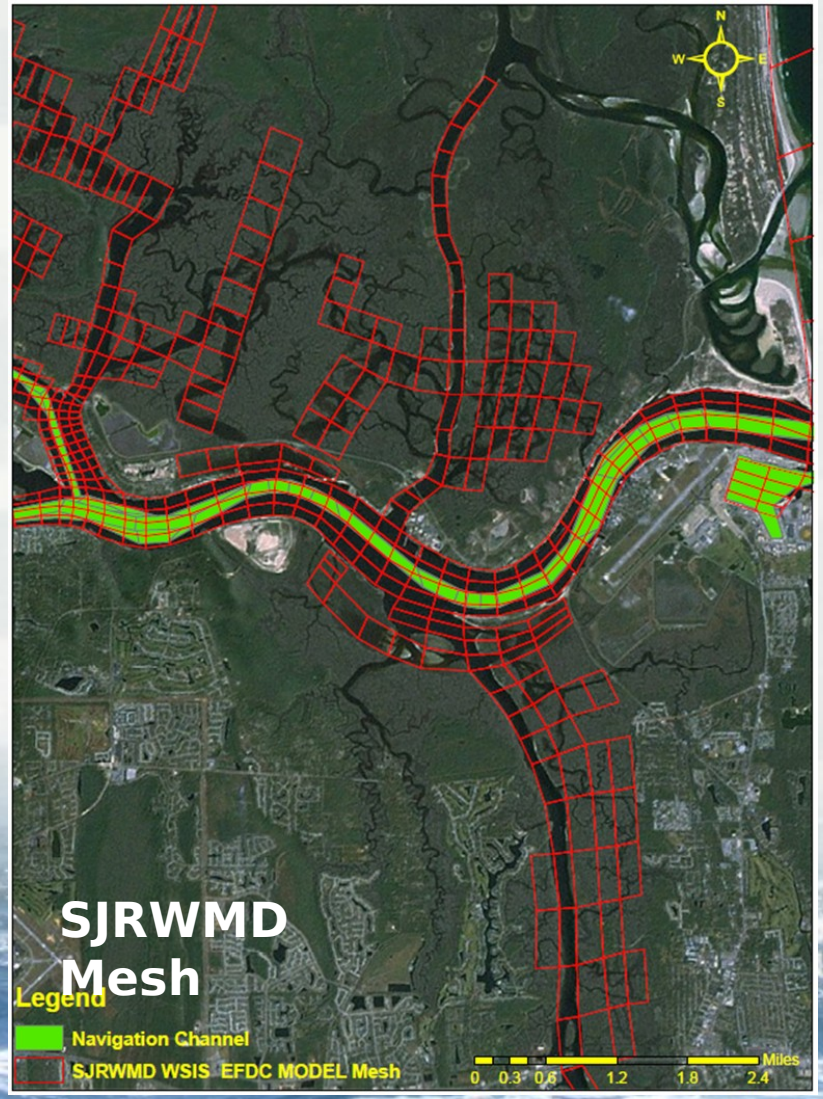


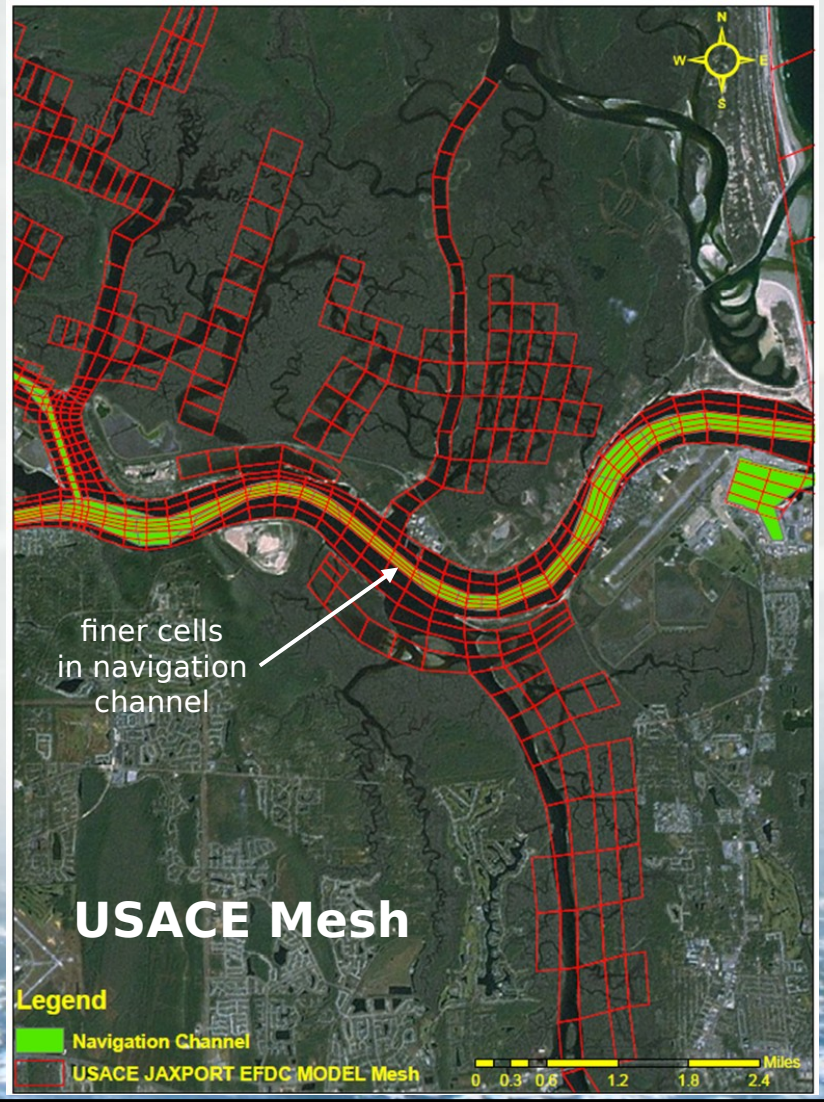


Study Overview

Jacksonville Harbor, Florida

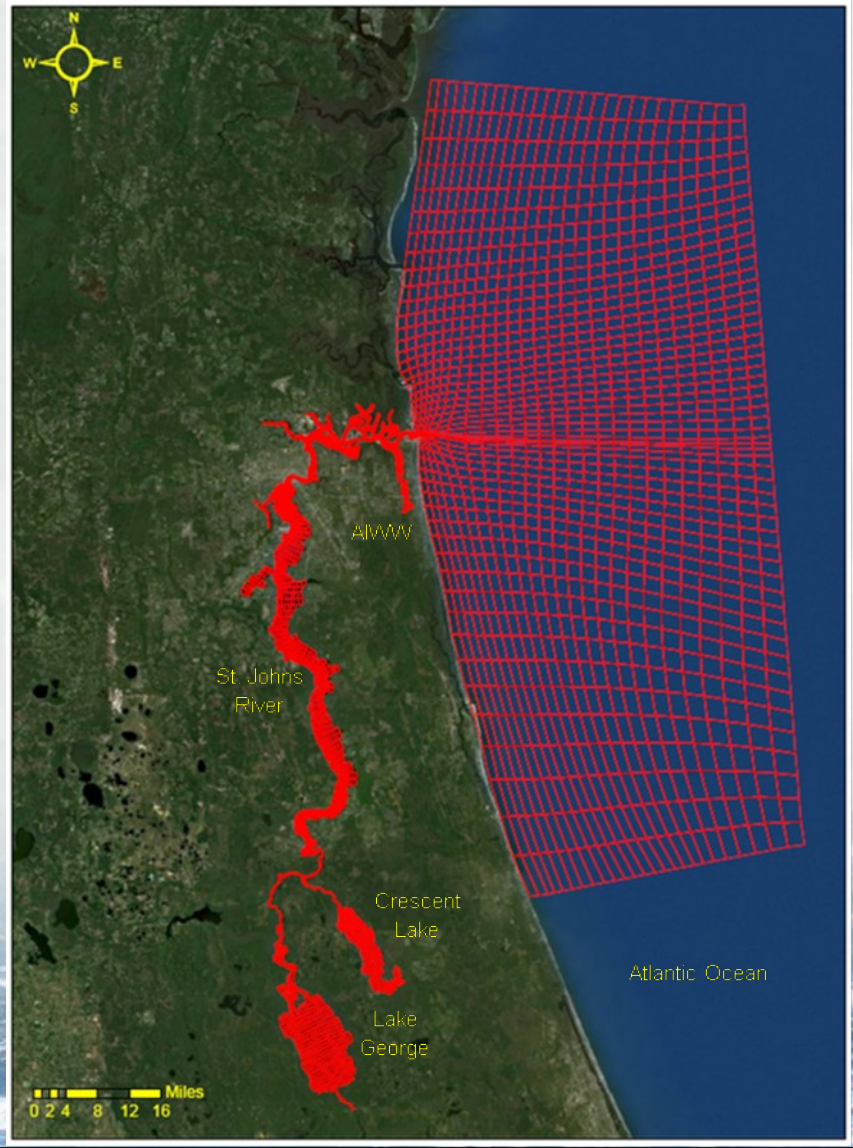
EFDC Hydrodynamic & Salinity Model Mesh





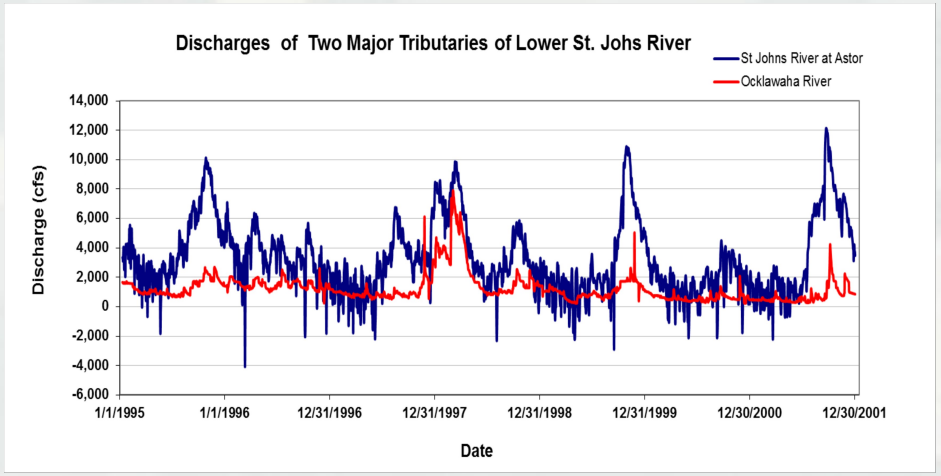
USACE EFDC Model Mesh

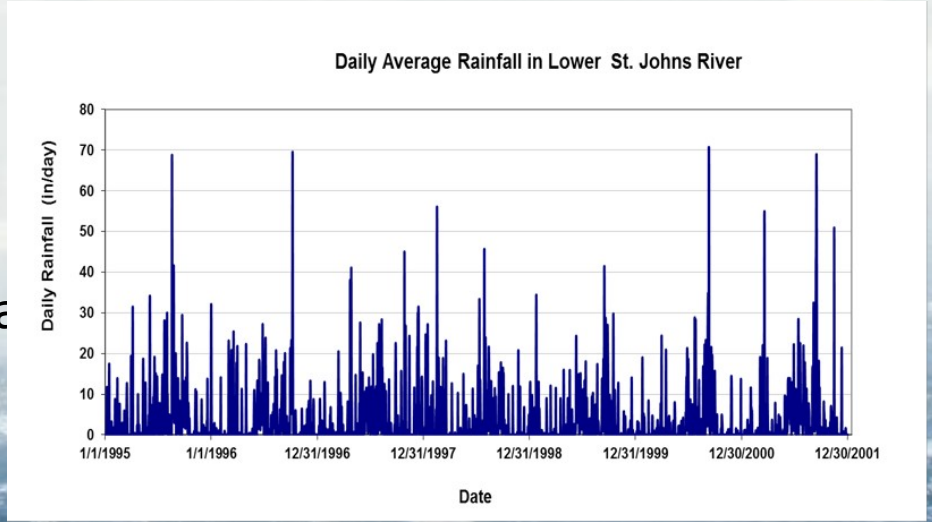
- model domain comprises 4,824 curvilinear horizontal water cells
- six equally divided layers in the vertical direction
- model variables are
  - water surface elevation
  - velocity
  - salinity



Model Boundary Conditions

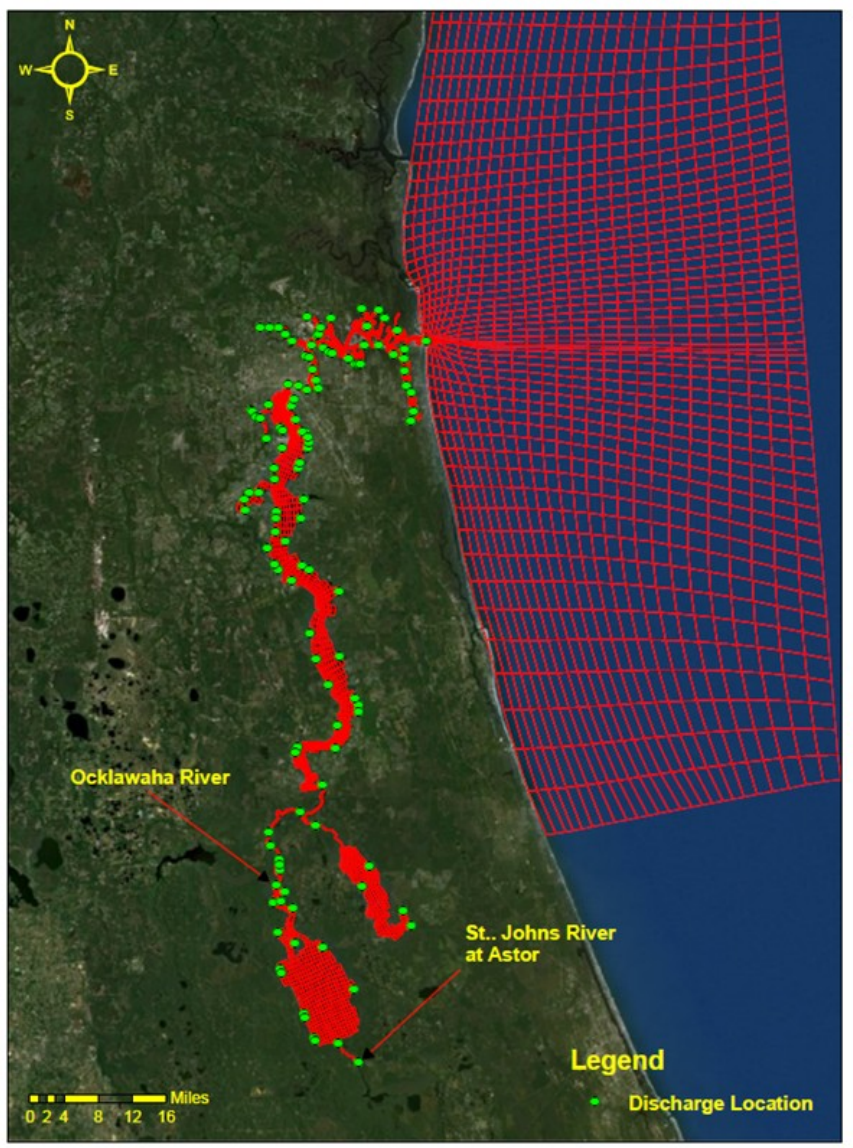
- Ocean water level
- Lateral inflows
- Rainfall and Evaporation
  - Jax Int'l Airport, Jax Beach, Federal Point, Crescent City, and Deland
- Wind
  - Jax Int'l Airport, Hastings, Gainesville Reg. Airport, Daytona Beach Int'l Airport, a Umatilla
- Salinity



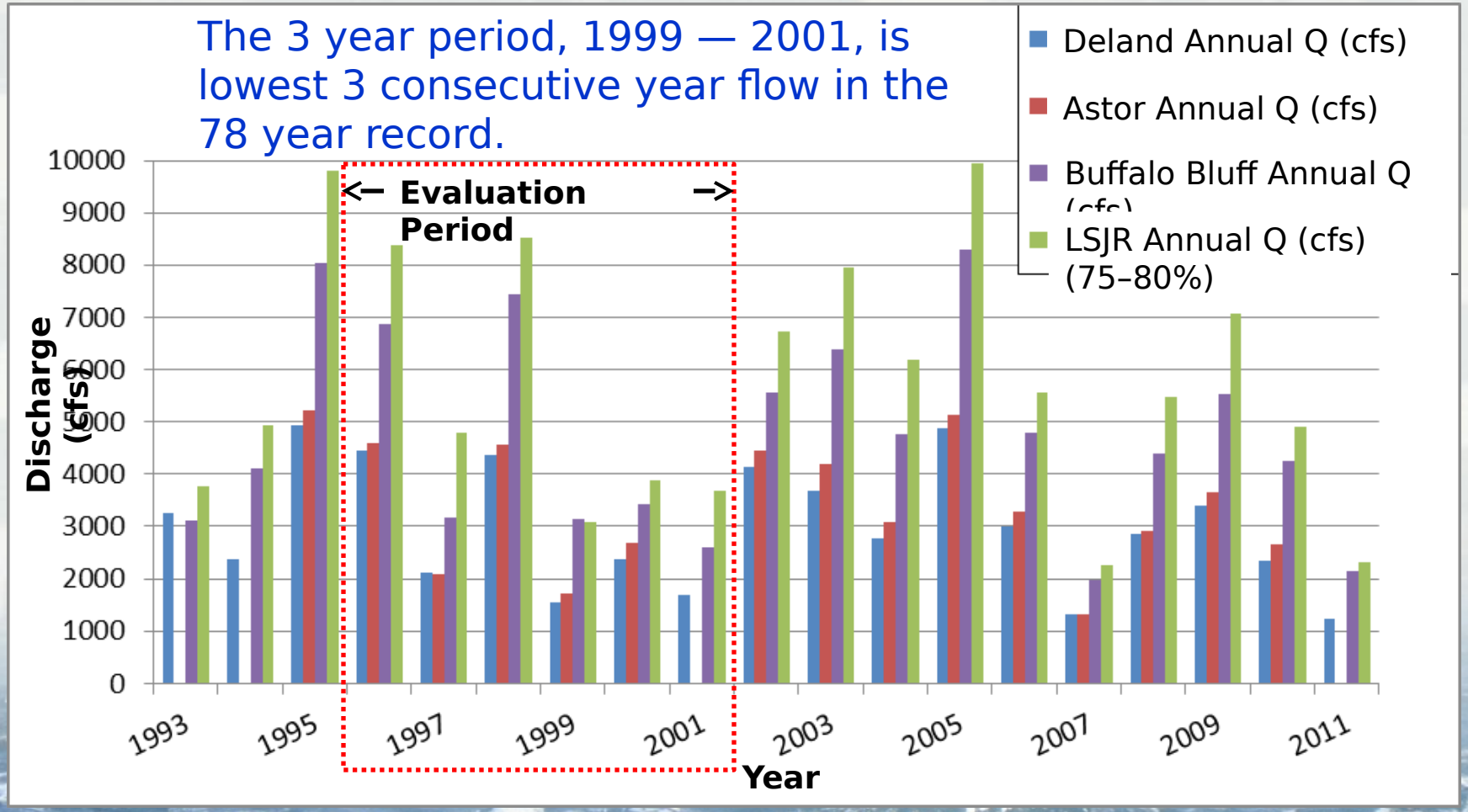


EFDC Model Lateral Inflows Conditions

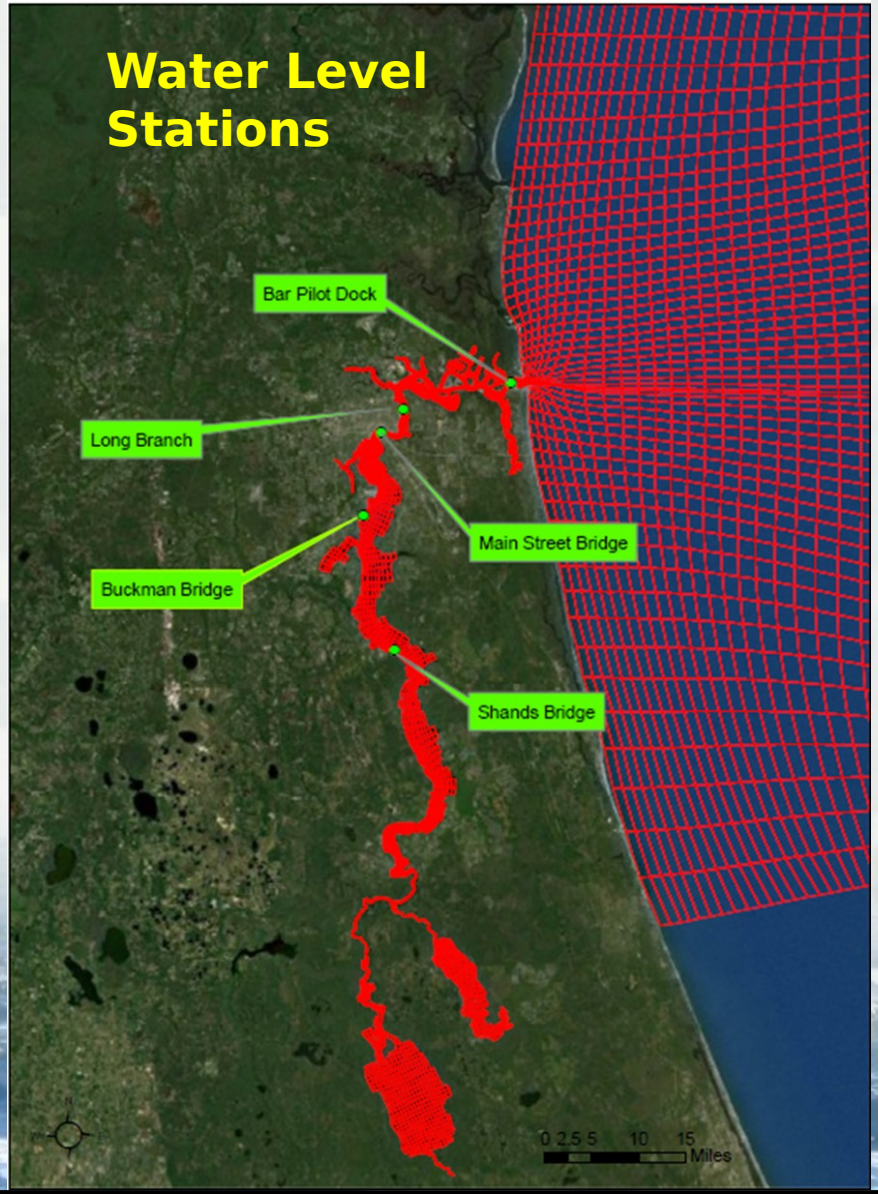
- 146 point source discharges
  - surface tributaries
  - springs
  - wastewater treatment outfalls
- Gauged inflows for model validation
- SJRWMD HSPF Model flows
  - ungauged inflows (validation)
  - production runs
  - 1995 landuse
- small wastewater

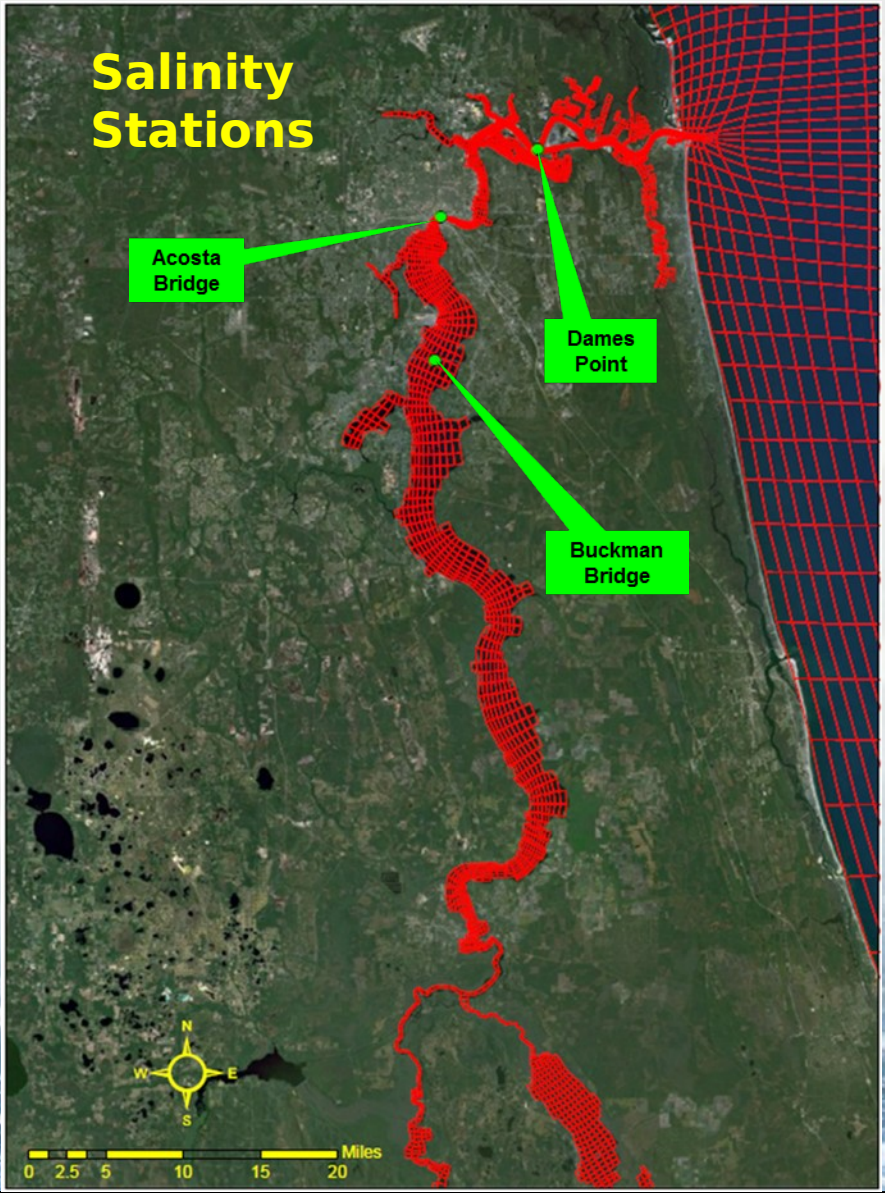


Hydrologic Conditions Based on USGS Gage Discharges



Model Validation Stations



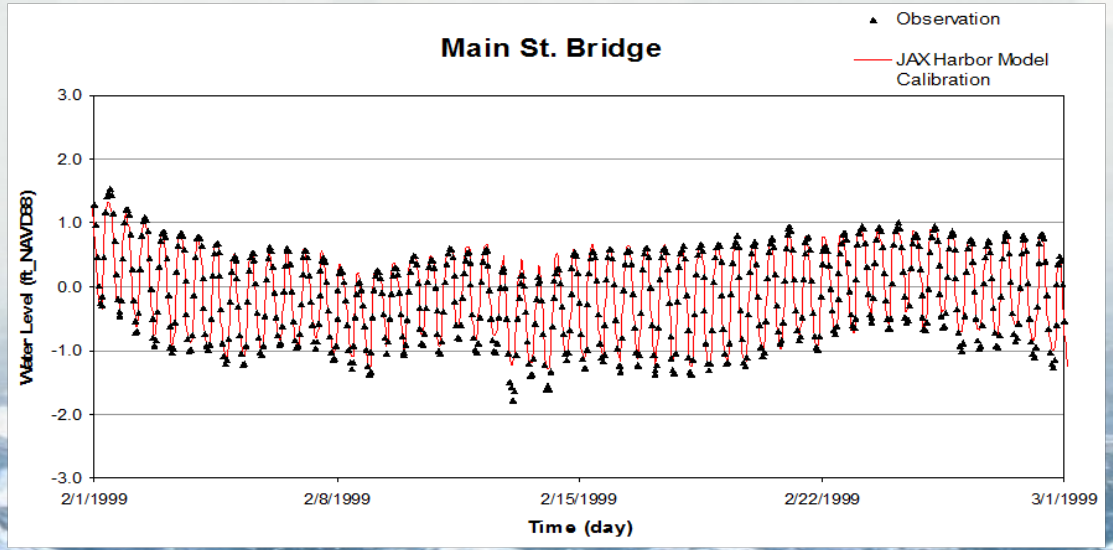


Model Re-Calibration (Water Level)

Statistics for Dry Period (12/1/1998 – 4/1/1999)

Station Parameters	Bar Pilot Dock	Long Branch	Main St. Bridge	Buckman Bridge	Shands Bridge
Correlation Coefficient, R	0.992	0.988	0.986	0.976	0.974
Root Mean Square Error, RMSE (ft)	0.285	0.154	0.148	0.118	0.108

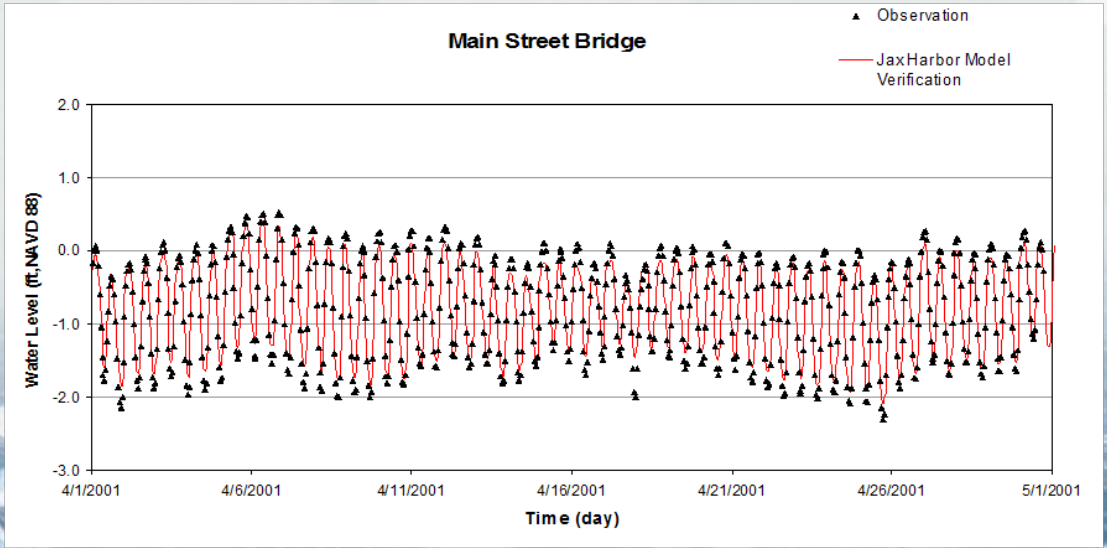
- Correlation Coefficient — ability to predict trend (~ 1.0 for perfect model)
- RMSE — indication of model accuracy (~0.0 for perfect model)



Model Re-Verification (Water Level)

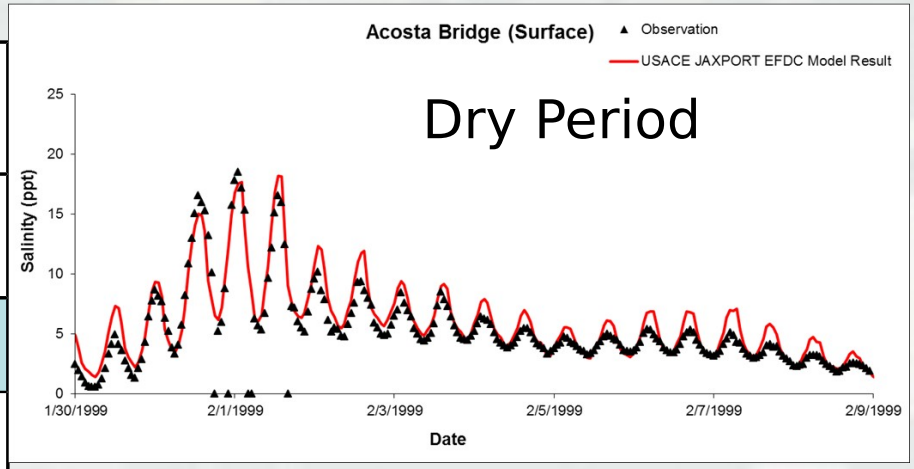
Statistics for Dry Period (4/1/2001 – 8/1/2001)

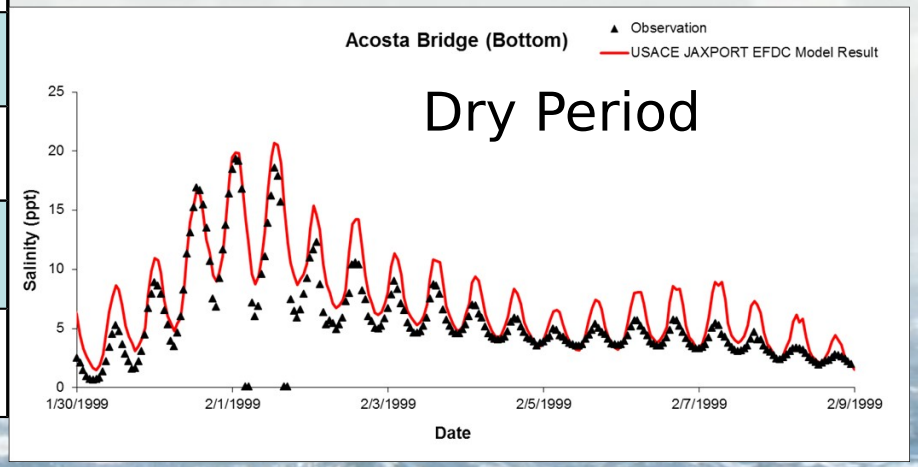
Station Parameters	Bar Pilot Dock	Long Branch	Main St. Bridge	Buckman Bridge	Shands Bridge
Correlation Coefficient, R	0.993	n/a	0.986	0.978	0.977
Root Mean Square Error, RMSE (ft)	0.279	n/a	0.144	0.092	0.092



Model Re-Calibration (Salinity)

Stations	Wet Period (12/1/1997 – 4/1/1998)		Dry Period (12/1/1998 - 4/1/1999)		Wind Conditions (8/1/1996 – 12/1/1996)	
	Correlation Coefficient	RMSE (ppt)	Correlation Coefficient	RMSE (ppt)	Correlation Coefficient	RMSE (ppt)
Dames Point (Surface)	0.889	3.835	0.864	2.278	0.925	3.677
Dames Point (Bottom)	0.883	4.110	0.827	3.040	0.936	2.265
Acosta Bridge (Surface)	0.956	0.466	0.938	1.581	0.938	1.931
Acosta Bridge (Bottom)	0.955	0.460	0.940	2.308	0.928	1.954
Buckman Bridge (Surface)	0.934	0.017	0.887	0.567	0.813	0.848
Buckman Bridge (Bottom)	0.933	0.017	0.836	1.374	0.828	1.994

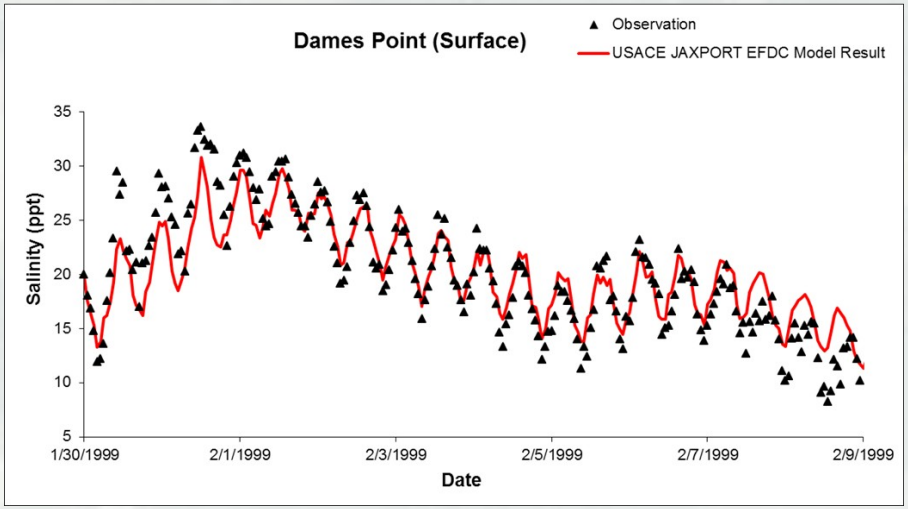


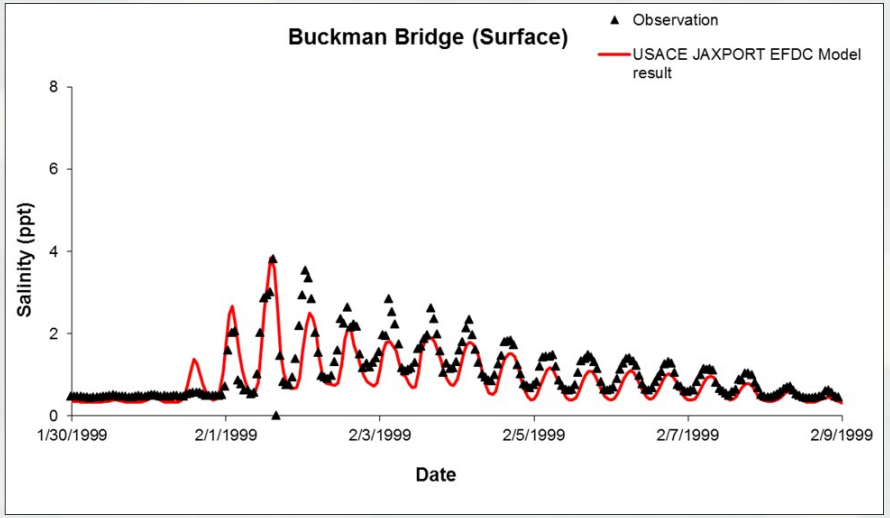


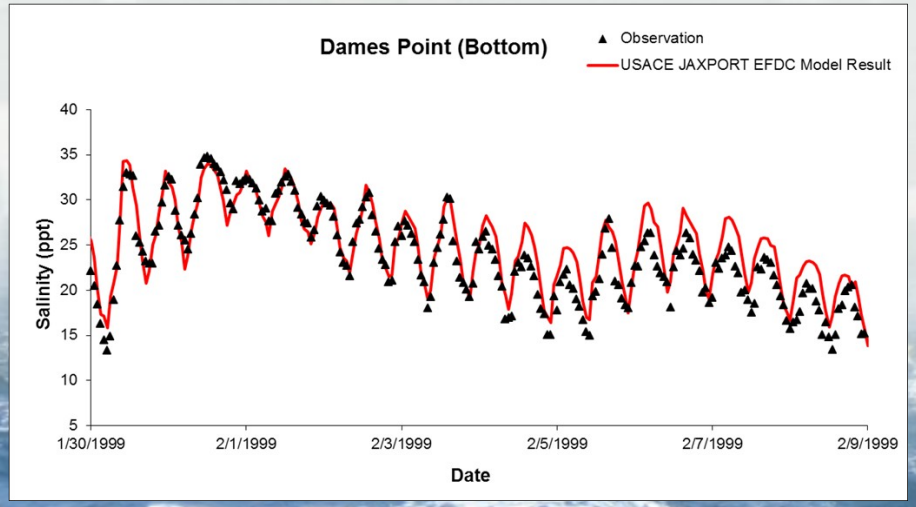
- Correlation Coefficient — ability to predict trend (~ 1.0 for perfect model)
- RMSE — indication of model accuracy (~0.0 for perfect model)

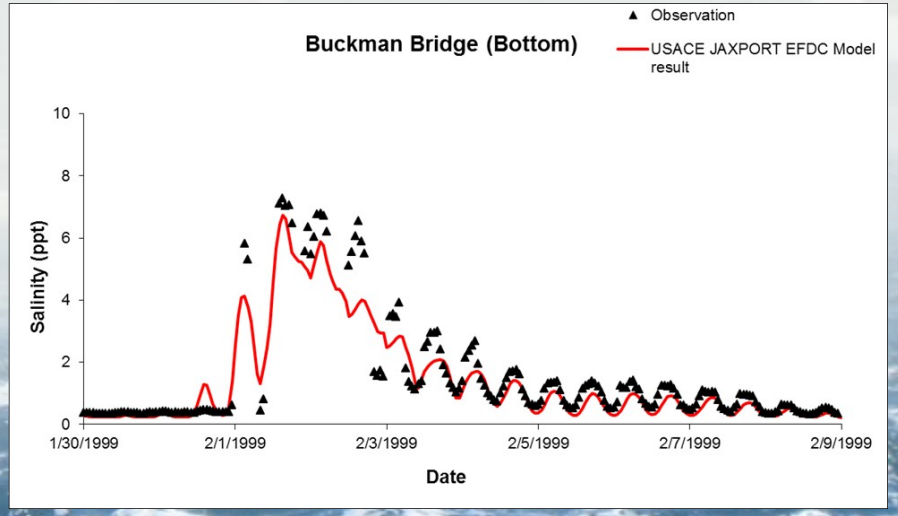
Model Re-Calibration (Salinity)

Dry Period



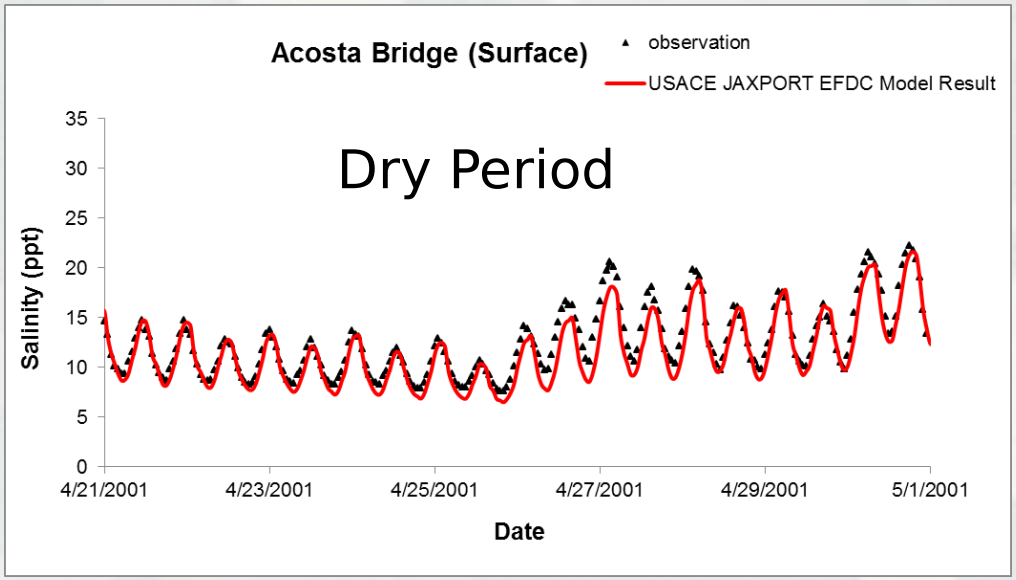


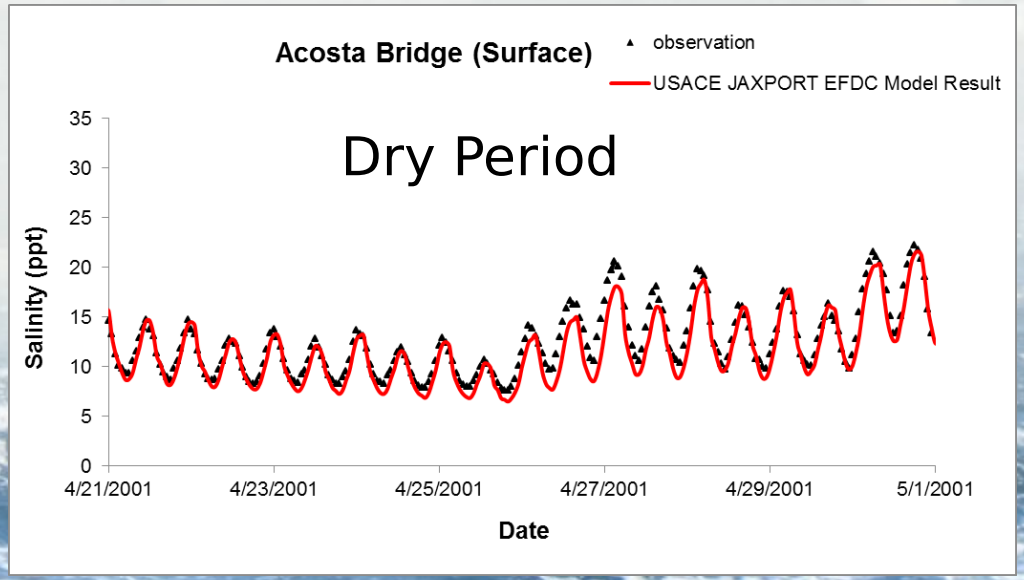




Model Re-Verification (Salinity)

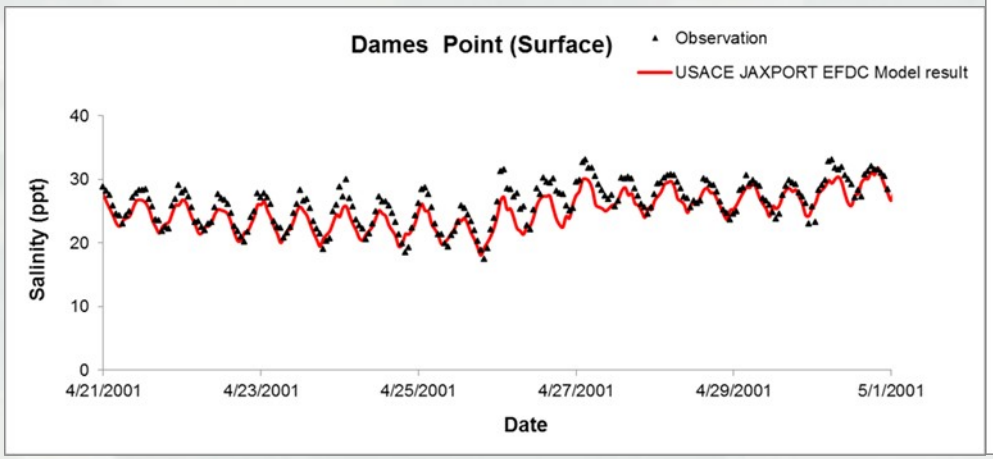
Stations	Wet Period (8/1/2001 – 12/1/2001)		Dry Period (4/1/2001 – 8/1/2001)	
	Correlation Coefficient	RMSE (ppt)	Correlation Coefficient	RMSE (ppt)
Dames Point (Surface)	0.893	5.963	0.788	2.376
Dames Point (Bottom)	0.819	6.189	0.744	2.640
Acosta Bridge (Surface)	0.899	2.665	0.909	2.008
Acosta Bridge (Bottom)	0.907	0.904	0.940	1.866
Buckman Bridge (Surface)	0.490	0.904	0.925	0.951
Buckman Bridge (Bottom)	0.483	0.978	0.870	1.784

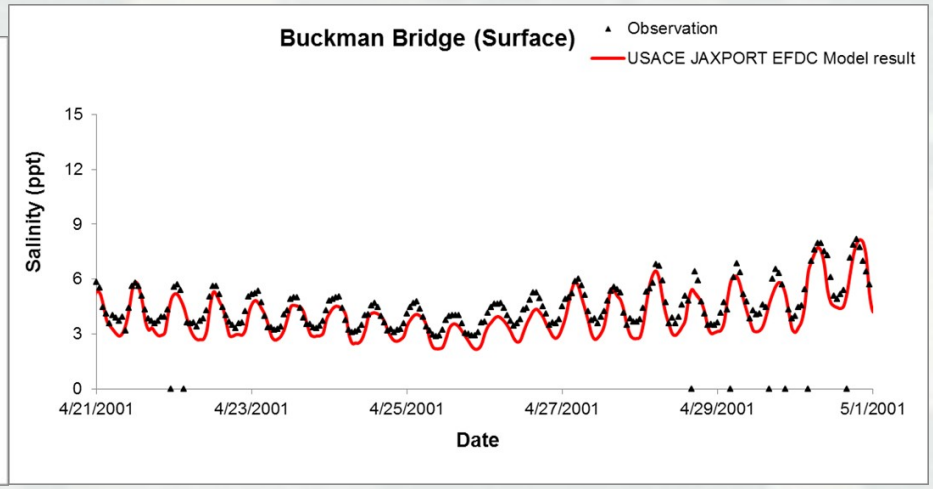


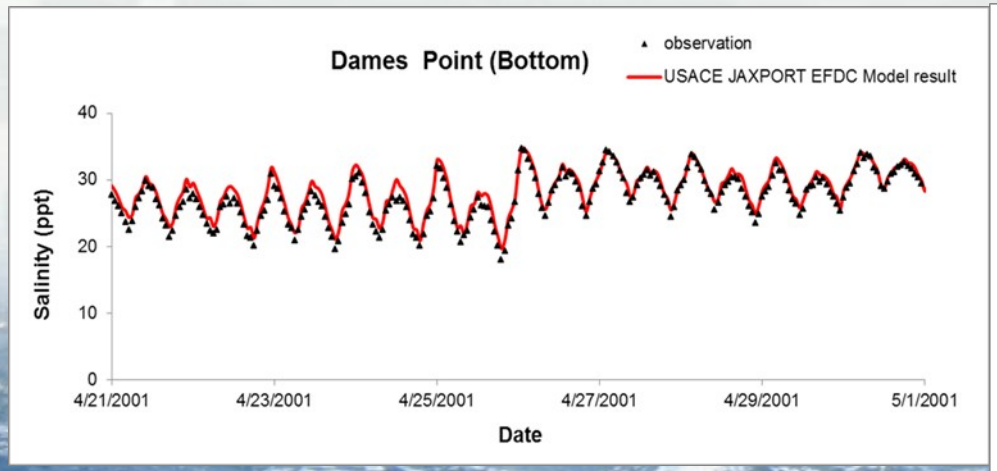


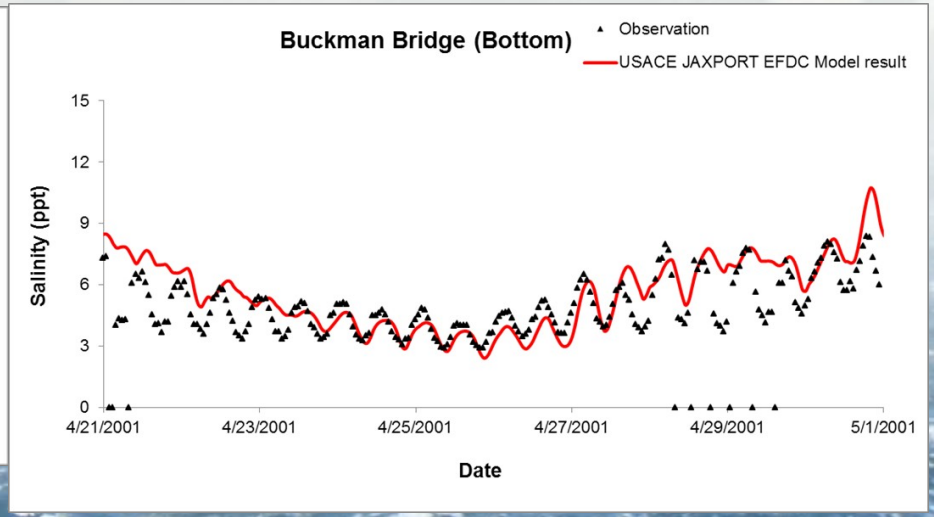
Model Re-Verification (Salinity)

Dry Period



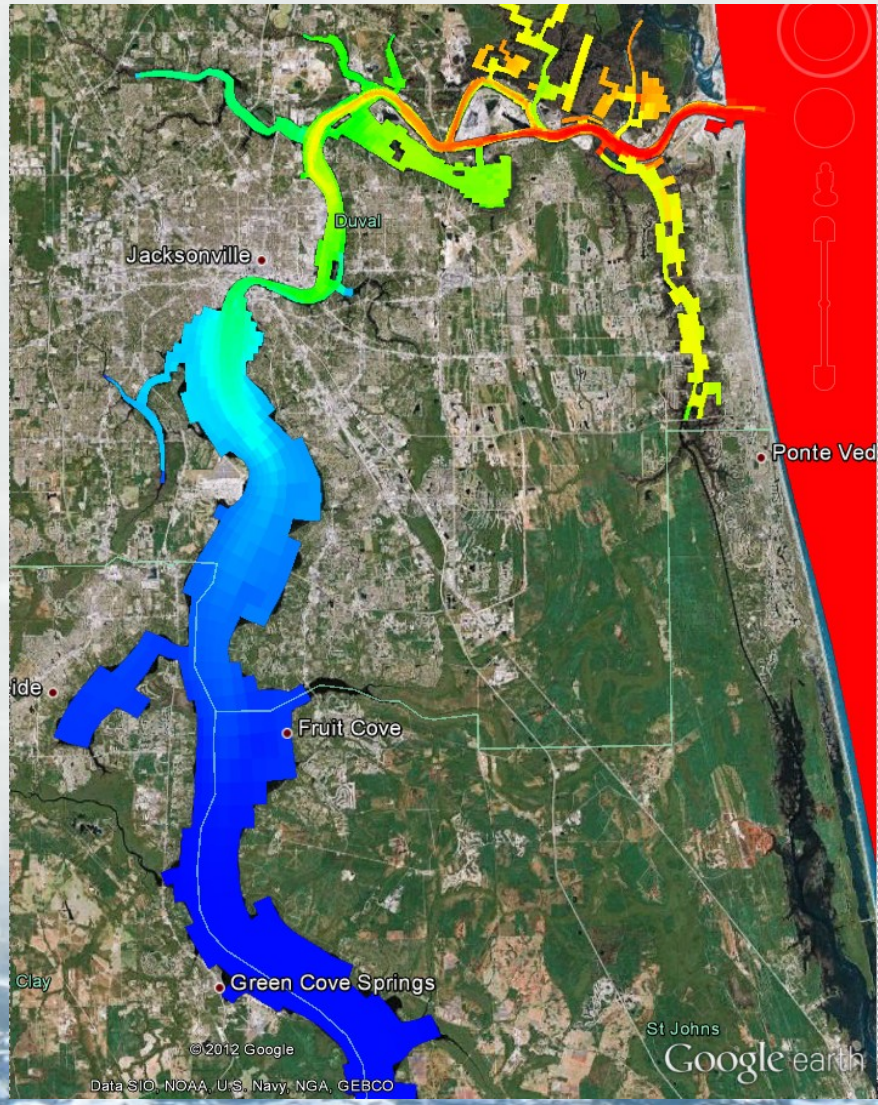






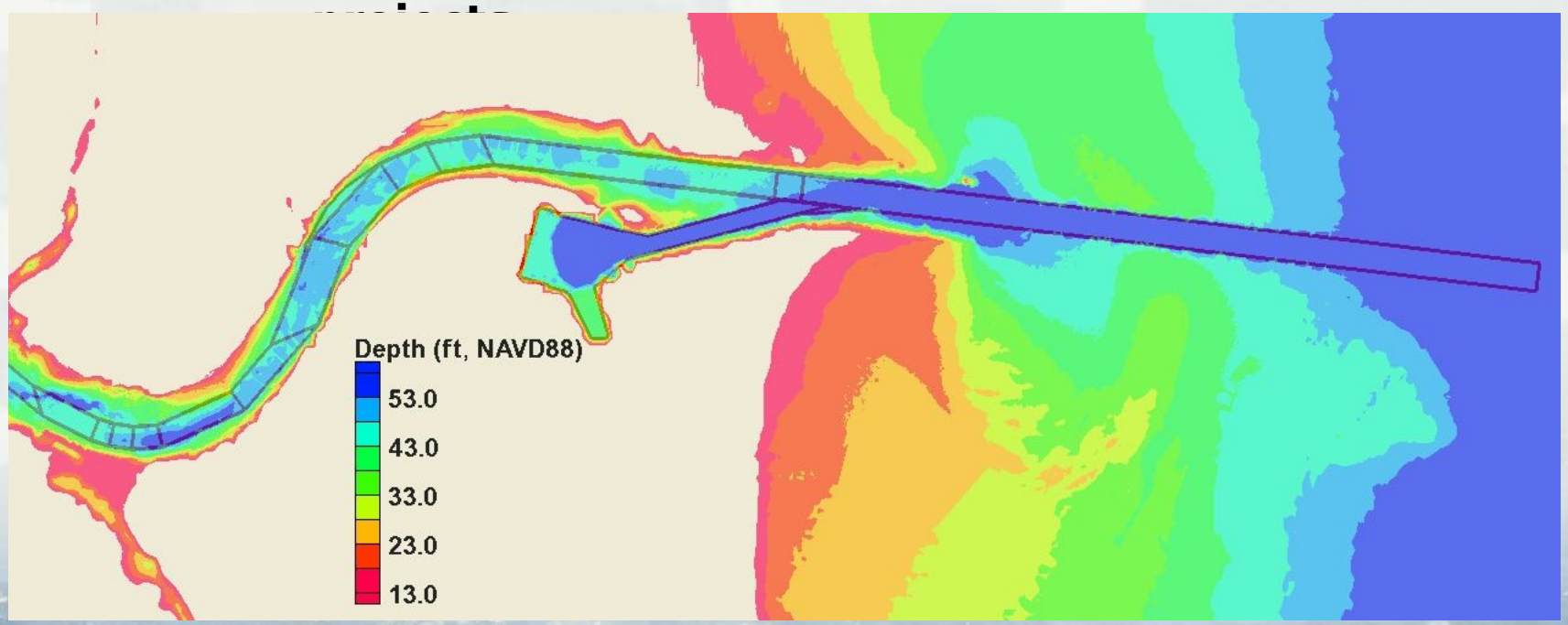
Model Validation

- EFDC model is validated with water level and salinity data collected in1995 to 2005 for wet period, dry period, and wind condition.
- Model is suitable for predicting hydrodynamic and salinity changes in the Lower St. Johns River from the potential channel deepening projects



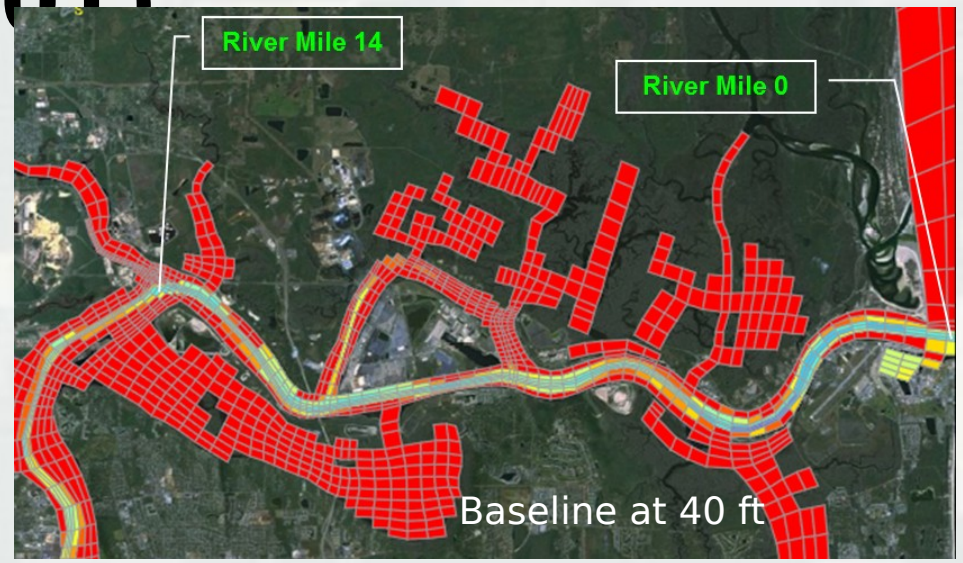
USACE Baseline Depths

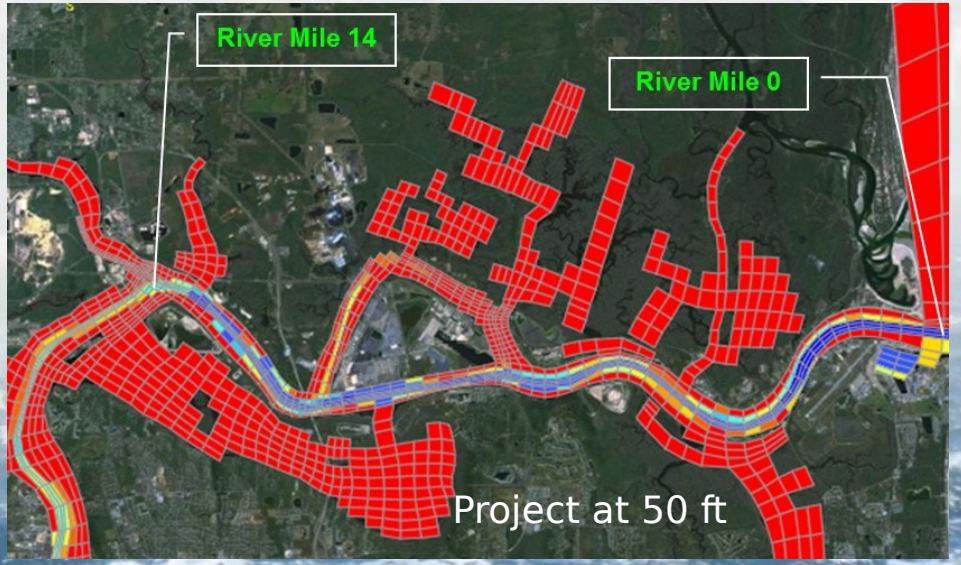
- 2009 & 2010 river & channel surveys
- Mayport and Mile Point



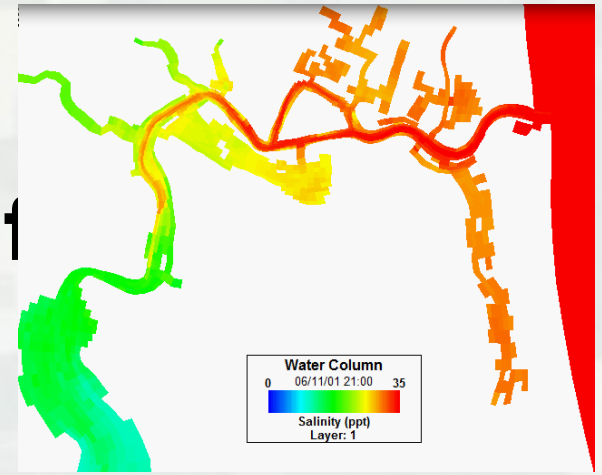
EFDC Model Applications (1996 – 2001)

- **SJRWMD Baseline**
- **USACE Baseline at 40 ft**
  - Compare with 44-, 46-, and 50-ft dredge
  - Compare with USACE recommended depth
- **USACE Baseline at 40 ft with SLC1 (0.39 ft) and 155 MGD Water Withdrawal**
  - Compare with 44-, 46-, and





EFDC Results (Animations)



- **USACE Baseline at 40 f**
  - **Velocity (Plan)**
  - **Salinity (Plan and Profile)**

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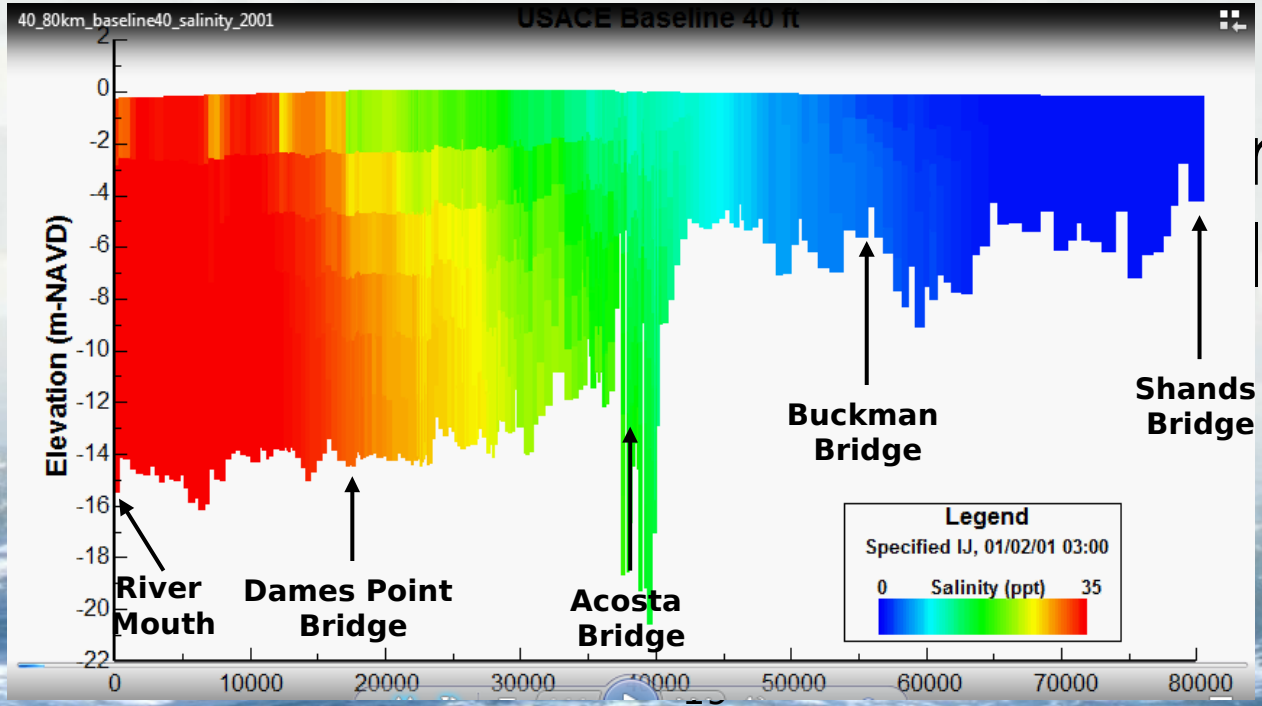


50-ft Channel Dredge Impact

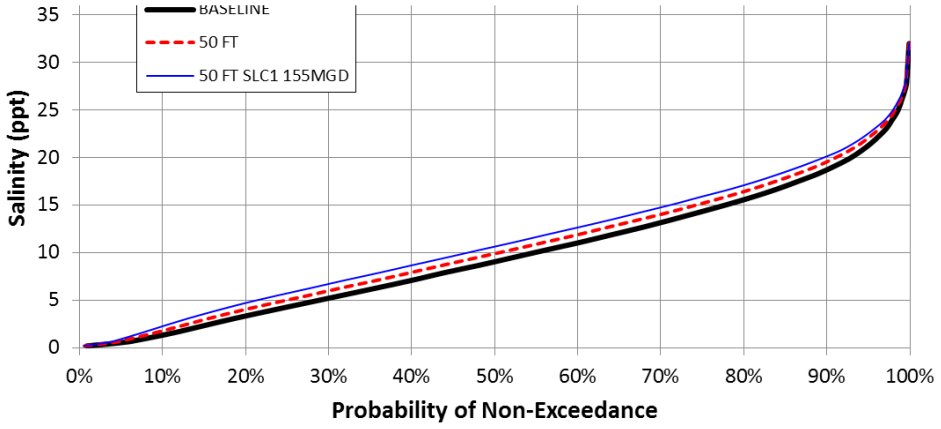
Acosta Bridge Salinity

- **Project at 50 ft (Deepening Only)**
  — mean salinity increases by 0.8 ppt
- **Project at 50 ft (with SLC1 &WW)** — mean salinity increases by 1.4 ppt

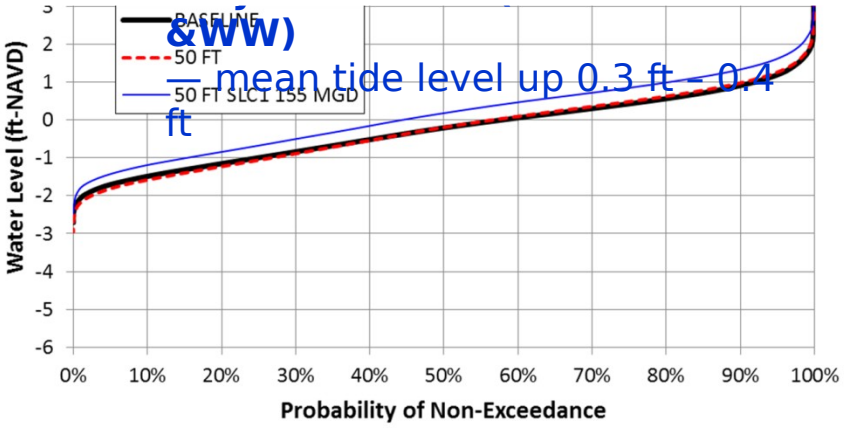
Main Street Bridge WL

- **Project at 50 ft (Deepening Only)**
  &WW)
  — mean tide level up 0.3 ft – 0.4 ft

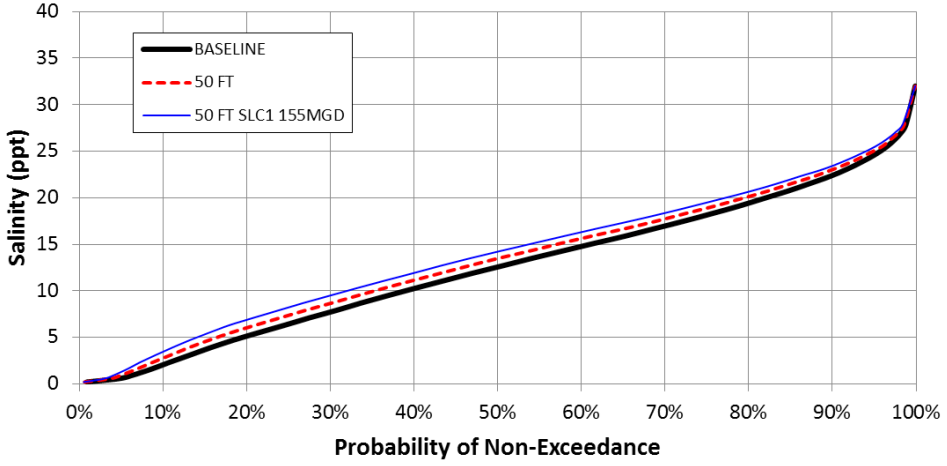
Acosta Bridge Surface Salinity (Baseline vs. Project at 50 ft)



Main Street Br WL (Baseline vs. Project at 50 ft)

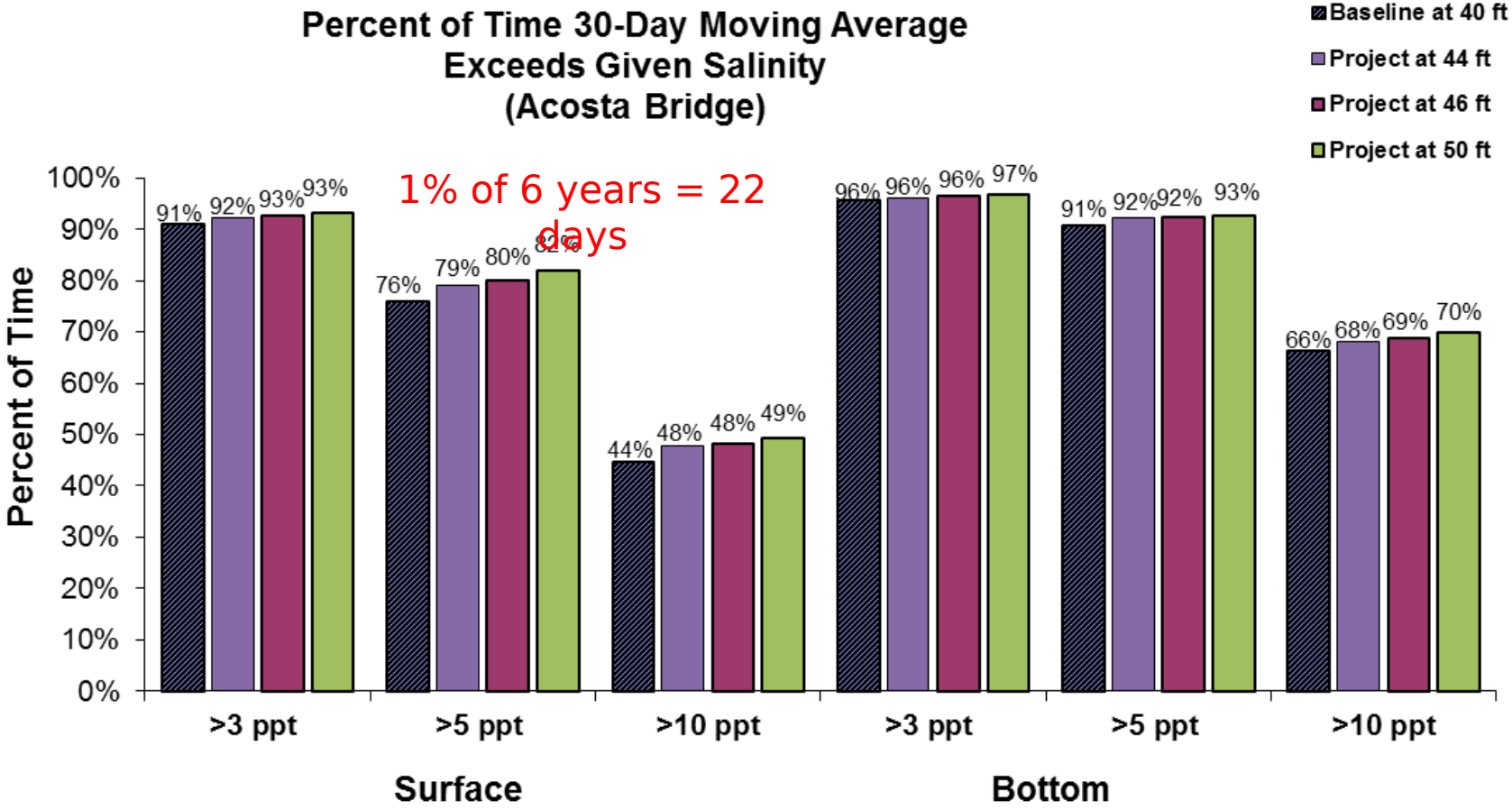


Acosta Bridge Bottom Salinity (Baseline vs. Project at 50 ft)



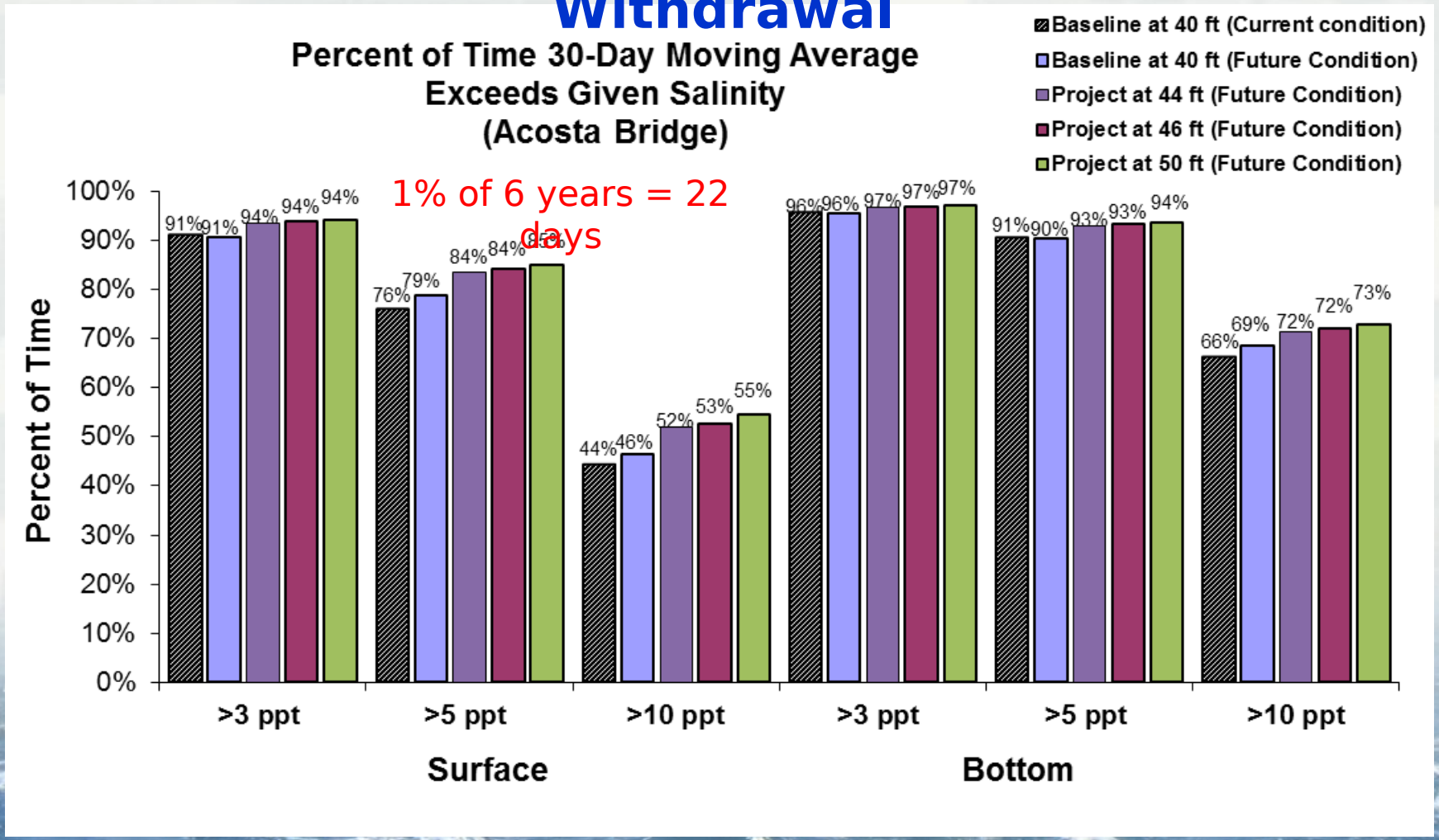
Salinity Impact (Acosta Bridge)

Channel Deepening Only



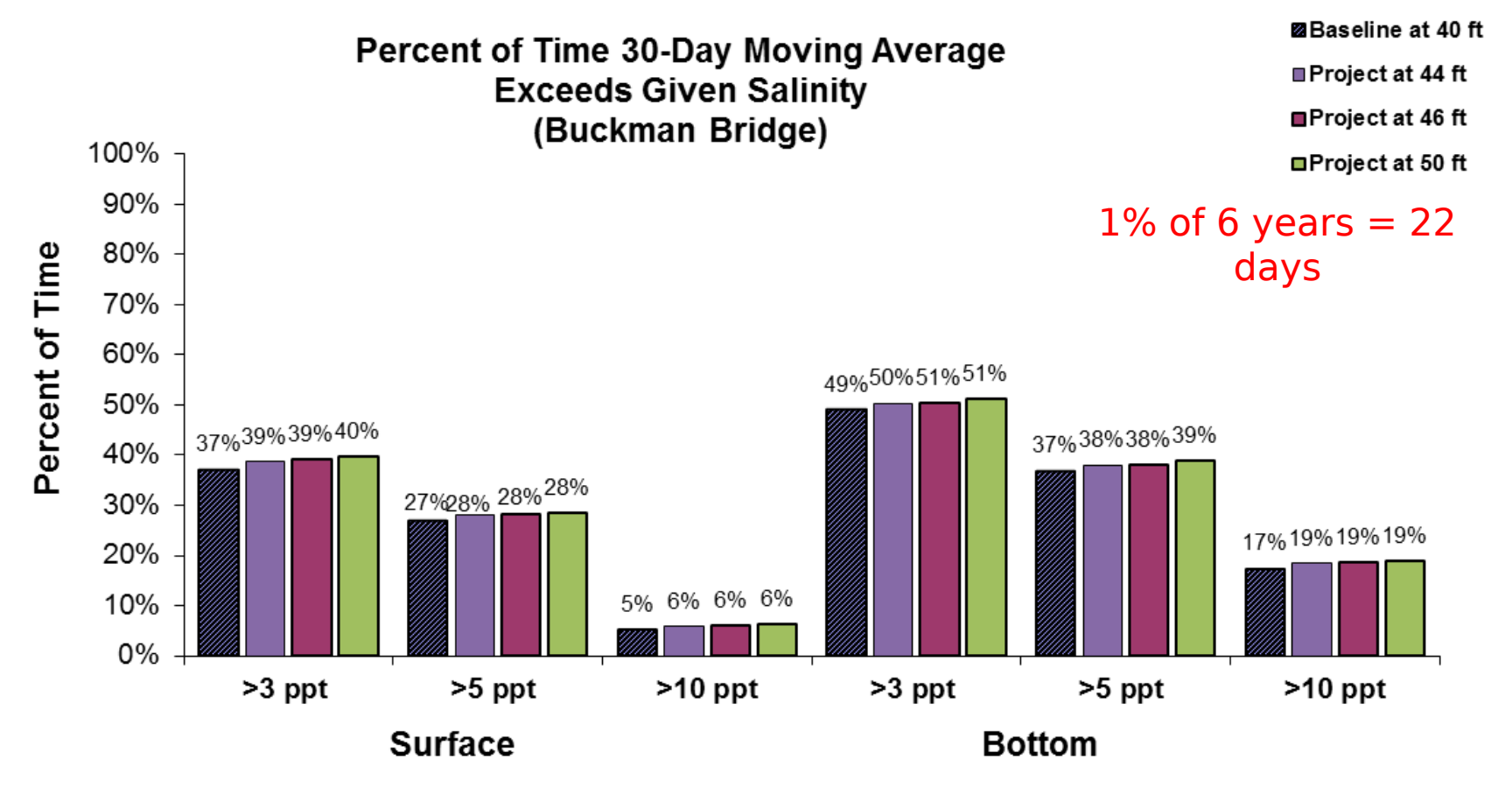
Salinity Impact (Acosta Bridge)

with 0.39 ft SLR and 155 MGD Water Withdrawal



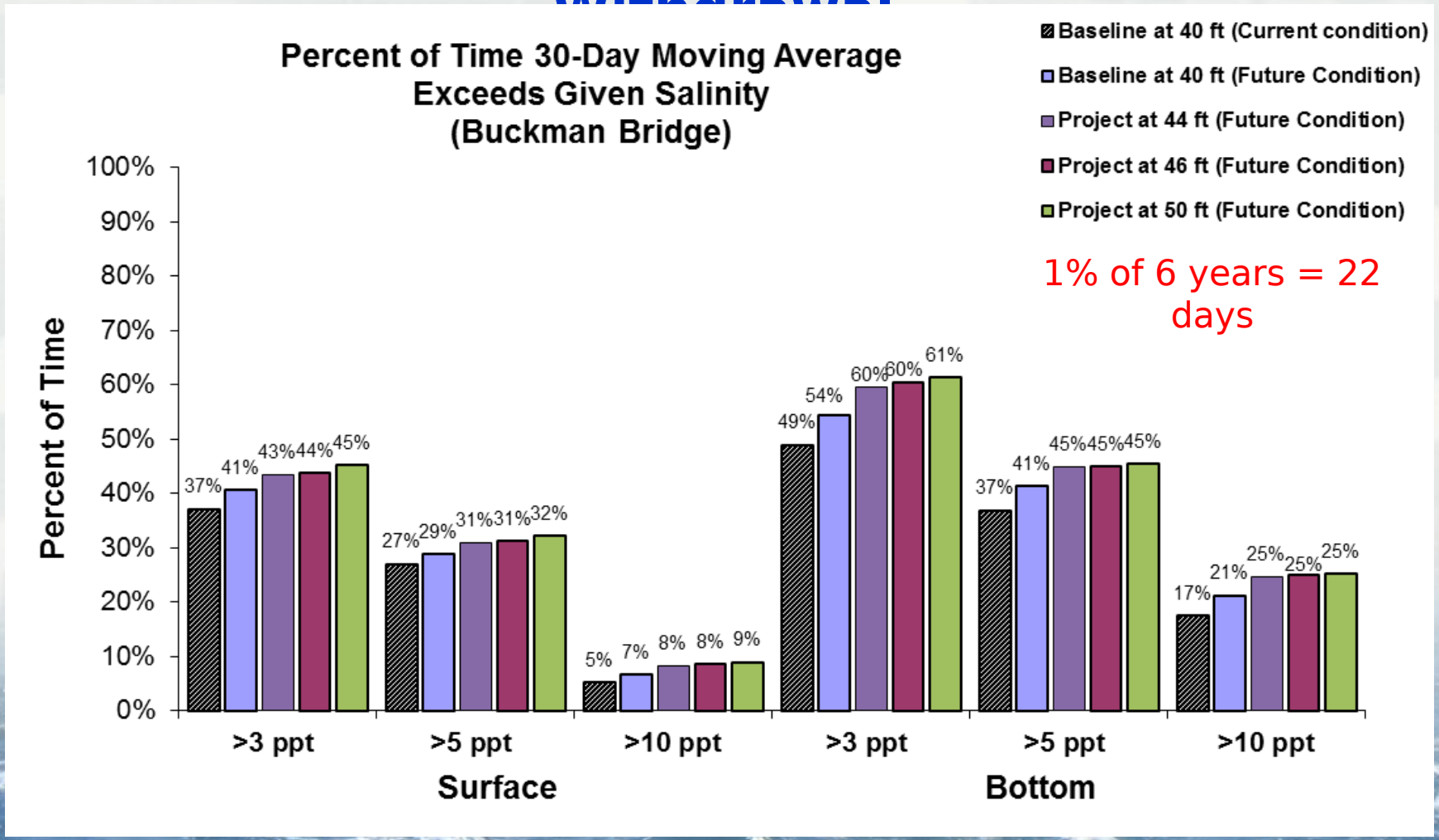
Salinity Impact (Buckman Bridge)

Channel Deepening Only



Salinity Impact (Buckman Bridge)

with 0.39 ft SLR and 155 MGD Water Withdrawal



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Discussion